

CLAIMS

1. A non-aqueous, substantially solvent-free and photoinitiator-free, particle beam curable ink having a viscosity less than 30m Pa.s at 60°C, comprising:

- 5 (i) a colorant; and  
(ii) a mixture of (meth)acrylate compounds;

wherein:

(a) the colorant is present in the ink in an amount of 0.1 to 14.9% by weight relative to the total weight of ink; and

10 (b) the mixture of (meth)acrylate compounds comprises c% of one or more mono (meth)acrylate compounds, d% of one or more di (meth)acrylate compounds and e% of one or more compounds having three or more (meth)acrylate groups, wherein the values of c%, d% and e% are by weight relative to the total weight of the mono (meth)acrylate compounds, di  
15 (meth)acrylate compounds and compounds having three or more (meth)acrylate groups and are such that the value of Formula (1) is less than or equal to 60:

$$c\% + 0.628 \left( \frac{d\%}{\sin 60} + \frac{e\%}{\tan 60} \right)$$

20 Formula (1)

2. An ink according to claim 1 wherein the colorant is a pigment.

25 3. An ink according to any one of the preceding claims wherein the mono (meth)acrylate compounds and di (meth)acrylate compounds are monomers.

4. An ink according to any one of the preceding claims wherein the value of Formula (1) is from 49 to 55.8.

30 5. An ink according to any one of the preceding claims wherein the one or more mono (meth)acrylate compounds is or comprises isobornyl acrylate.

35 6. An ink according to any one of the preceding claims wherein the one or more di (meth)acrylate compounds is or comprises 1,6-hexanediol diacrylate.

7. An ink according to any one of the preceding claims wherein the one or more compound comprising three or more (meth)acrylate groups is or comprises trimethylolpropane triacrylate and/or ethoxylated trimethylolpropane triacrylate.

8. An ink according to any one of the preceding claims which further comprises a dispersant.

9. An ink according to any one of the preceding claims wherein the colorant is present in an amount of 1.1 to 8% by weight, relative to the total weight of the ink.

10. An ink according to any one of the preceding claims wherein the colorant is not white.

11. An ink according to any one of the preceding claims which is free from titanium dioxide.

12. An ink according to claim 1 comprising:

- (i) a yellow, magenta, cyan, black, blue, indigo, violet, green, orange or red pigment or a mixture comprising two or more thereof; and
- (ii) a mixture of (meth)acrylate compounds;

wherein:

- (a) the pigment is present in the ink an amount of from 1.1 to 8% by weight relative to the total weight of ink;
- (b) the mixture of (meth)acrylate compounds comprises c% of one or more mono (meth)acrylate compounds, d% of one or more di (meth)acrylate compounds and e% of one or more compounds having three or more (meth)acrylate groups, wherein the values of c%, d% and e% are by weight relative to the total weight of the mono (meth)acrylate compounds, di (meth)acrylate compounds and compounds having three or more (meth)acrylate groups and are such that the value of Formula (1) is from 40 to 60:

$$c\% + 0.628 \left( \frac{d\%}{\sin 60} + \frac{e\%}{\tan 60} \right)$$

Formula (1)

- (c) the one or more mono (meth)acrylate compounds are selected from the group consisting of cyclic trimethylolpropane formal (meth)acrylate, ethoxylated tetra hydrofurfuryl (meth)acrylate, phenoxy ethyl (meth)acrylate, trimethylol propane formal (meth)acrylate, lauryl (meth)acrylate, stearyl (meth)acrylate, monomethoxy neopentyl glycol propoxylate mono (meth)acrylate, monomethoxy tripropylene glycol mono (meth)acrylate, 2-(2-ethoxyethoxy) ethyl (meth)acrylate, iso-decyl (meth)acrylate, iso-octyl (meth)acrylate, iso-nonyl (meth)acrylate, tridecyl (meth)acrylate, iso-bornyl (meth)acrylate, ethoxyl nonyl phenol (meth)acrylate,

ethoxylated phenol (meth)acrylate, 2-hydroxyl ethyl (meth) acrylate, 4-hydroxyl butyl (meth) acrylate, 2-hydroxy propyl (meth) acrylate, iso-butyl (meth) acrylate, tert-butyl (meth) acrylate, cetyl (meth)acrylate, cyclohexyl (meth)acrylate, ethyl hexyl (meth)acrylate, 2-dimethyl amino ethyl (meth) acrylate, trifluoro ethyl (meth)acrylate, 3-methoxy butyl (meth)acrylate, dicyclopentenyl (meth)acrylate, polyethylene glycol mono (meth)acrylate and poly propylene glycol mono (meth)acrylate and mixtures thereof;

(d) the one or more di (meth)acrylate compounds are selected from the group consisting of di(meth)acrylates of 1,4 butane diol, 1-6 hexane diol, neopentyl glycol, mono, di, tri and poly ethylene glycols, mono, di, tri and poly propylene glycols, mono methoxy ethoxylated trimethylolpropane, propoxylated neopentyl glycol, ethoxylated neopentyl glycol, 1,2 butylene glycol and ethoxylated hexane diol and mixtures thereof; and

(e) the one or more compounds having three or more (meth)acrylate groups are selected from the group consisting of trimethylol propane tri(meth)acrylate, ethoxylated trimethylol propane tri(meth)acrylate, propoxylated trimethylol propane tri(meth)acrylate, glycerol tri(meth)acrylate, propoxylated glycerol tri(meth)acrylate, pentaerythritol tri(meth)acrylate, pentaerythritol tetra(meth)acrylate, tris (2-hydroxyethyl) isocyanurate triacrylate, ditrimethylol propane tetra (meth)acrylate, ethoxylated pentaerythritol tetra(meth)acrylate, ethoxylated di-pentaerythritol tetra (meth)acrylate, tetra methylol methane tetra (meth)acrylate, multifunctional (meth)acrylate-urethanes, (meth)acrylate-polyesters and (meth)acrylate acrylics and mixtures thereof.

13. An ink according to any one of the preceding claims which has been filtered through a filter having a mean pore size of less than 10 $\mu$ m.

14. Use of the ink according to any of the preceding claims as an ink jet printing ink.

15. A process for printing an image onto a substrate comprising printing an image onto a substrate using an ink according to any one of claims 1 to 13 by means of an ink jet printer and curing the ink.

16. A process according to claim 15 wherein the curing is performed using an electron beam.

17. A printed substrate obtained by the process of claim 15 or 16.

18. An ink jet printer cartridge comprising a chamber and an ink wherein the ink is present in the chamber and is as defined in one of claims 1 to 13.

19. A substrate printed with an image using an ink according to any one of the claims 1 to 13.

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